StarTiger 'under skin' feature

The development of the StarTiger 'colour' terahertz imager, integrates planar antenna, planar detector, micro machining, photonic band gap materials and miniaturised back-end electronics technologies. One of the team members aligns the scanning mechanism of the first prototype

A special R&D team has taken just months to achieve a significant advance in terahertz imaging technology. The StarTiger project, funded by the ESA (European Space Agency) gathered researchers from Europe at the CCLRC Rutherford Appleton Laboratory (RAL). The work has led to technology firsts and patent applications.

ESA wanted to investigate terahertz imaging in space research and the Star Tiger concept of carrying out the research. Aimed at rapid new technology development, StarTiger was aligned with the Agency's innovation policy.

Terahertz radiation occupies the spectrum between infrared and microwave regions. Space applications presently include astronomy, atmosphere physics, earth and environment monitoring as well as medical imaging and security systems.

The StarTiger team demonstrated its first passive terahertz image of a hand, less than three months into the four-month project.

Micro-fabricated terahertz detectors and an advanced imaging system incorporating a two-colour 16-pixel array the size of a postage stamp were incorporated with silicon MEMs. The system images confirm the mysterious nature of terahertz waves unexpectedly showing details of 'under skin' features.

Access to 1st class facilities, the opportunity to focus on tasks with minimal distractions and administrative overheads seems to prove the Star Tiger concept.

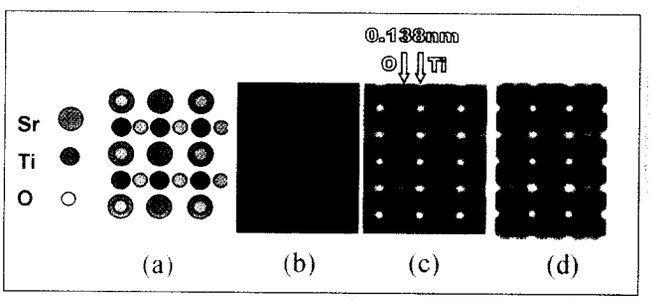
ORCS carry the TORCH

Finland's Optoelectronics Research Centre (ORC) at Tampere University of Technology has won a two-year €1.08m National Technology Agency grant to fund development of high-intensity ultrashort-pulse fibre lasers, tuneable broadband light emitters in optical fibre systems, and dilute nitride lasers oscillating at the wavelength of 1.3mm. Project TORCH (Towards Lighter Technologies) will explore ways to achieve femtosecond-regime optical pulses integrated with semiconductor, saturable absorber mirrors, and develop GaInNAs edge emitting devices and VCSELs.

Prof. Markus Pessa, director of ORC said the crystal growth facilities includes five MBE systems and an opto device fabrication area. A new ORC building is almost completed and €1.4m funded as 'cost share' by the EU, Pirkanmaa TE-Centre (Finland) and industry.

ORC has achieved recognition for its work in GaInAsN work and designed and fabricated edge-emitting GaInAsN / GaAs quantum well lasers operating at 1.32μm. The layer structure is grown by MBE. Continuous-wave operation at low threshold current has been demonstrated at room temperature. Over 100mW light power in pulse mode and 40mW in cw mode have been achieved. For an uncoated 1.6mm long laser having a shallow ridge stripe the threshold current density is 563 A/cm2. In 2002, ORC demonstrated a photo-pumped 1.28μm continuous-wave vertical-cavity surface-emitting laser grown in a single nucleation process by MBE.

Oxygen molecule envisioning TEM



Strontium titanate ($SrTiO_3$) in the electron microscope. The structure (a, Sr = strontium, Ti = titanium, O = oxygen) is imaged with a "classical" electron microscope (b) and in comparison with the corrected microscope (c) in a simulation. Where previously only the heavy strontium atoms were discernible (b), the lighter oxygen atoms are now also directly visible (c). The scientists can even identify oxygen vacancies (d).

Scientists from Research Centre Jülich, the European Molecular Biology Laboratory in Heidelberg and Darmstadt University of Technology have made individual oxygen atoms visible with a TEM on perovskites materials.

A technique has been developed to correct the aberrations in the microscope which leads to blurred images in which no individual oxygen atoms can be seen. Ceramic materials on the basis of oxides with perovskite structure - including barium and strontium titanate - play a major role in modern electronics. Perovskites are also the base material for high-temperature superconductors, increasingly needed in ultrathin films.

A major problem is the correct adjustment of oxygen content which critically determines the electrical properties. The absence of a few oxygen atoms in the electrically active TF zones would impair its function says Prof. Knut Urban from the Jülich Institute of Solid State Research. TEM can check this atomic precision but distorted images mean no individual oxygen atoms can be recognised.

Now 'aberration-corrected' TEM with a specially shaped magnetic lens, permits oxygen to be imaged atomically for the first time, enabling oxygen content to be measured quantitatively in atomic dimensions. Urban (who worked with microscopy specialist, Dr Markus Lentzen and materials scientist Dr Chun Lin Jia) is convinced that this will replace the classical high-resolution electron microscope in many materials science fields.